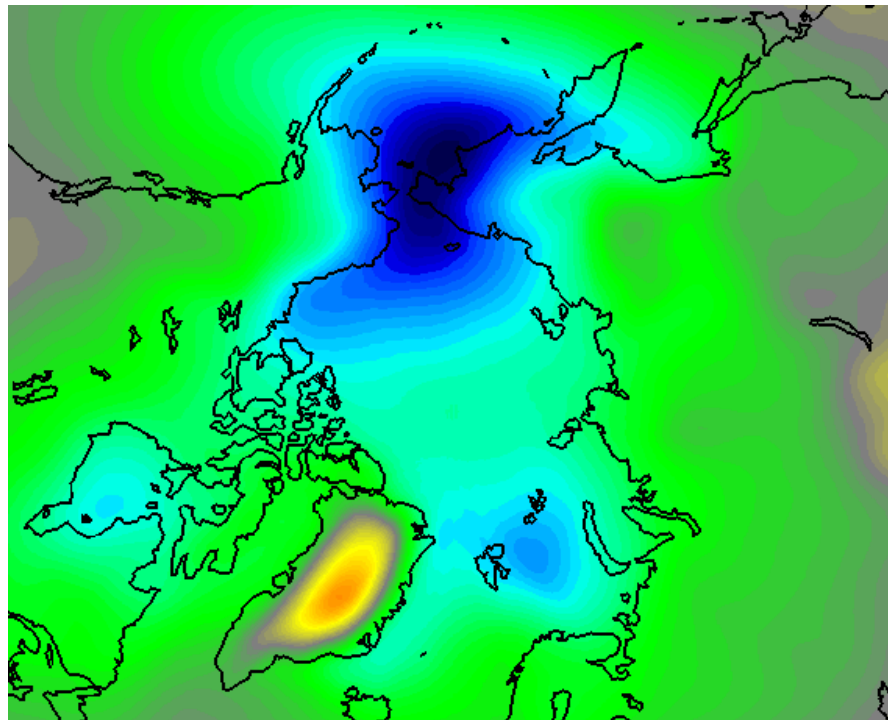


Downscaling for Alaska's Coastal Seas: Sample results for future temperatures

John Walsh and Sarah Trainor
Alaska Center for Climate Assessment and Policy
University of Alaska, Fairbanks



STAMP presentation, 24 Sept. 2012

Project objectives

- **Deliver (to AOOS database) high-resolution spatial fields of temperature, precipitation and wind for the Alaskan coastal and offshore regions**
- **Develop downscaled future scenarios for 21st-century time-slices**
- **Address the potential impacts of these changes in the context of a changing sea ice cover**

Relevant to ongoing and future changes in

-- marine ecosystems

-- marine navigation

-- coastal vulnerability (flooding, erosion)

Projections based on global climate models

- A set of 20+ models have been compared with data for surface air temperature, sea level pressure, and precipitation
- Models that perform best over Alaska have been selected:

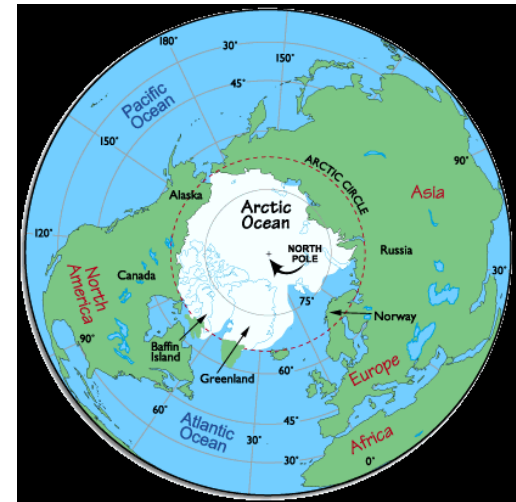
MRI (Japan)

GISS (U.S.)

GFDL (U.S.)

CNRM (France)

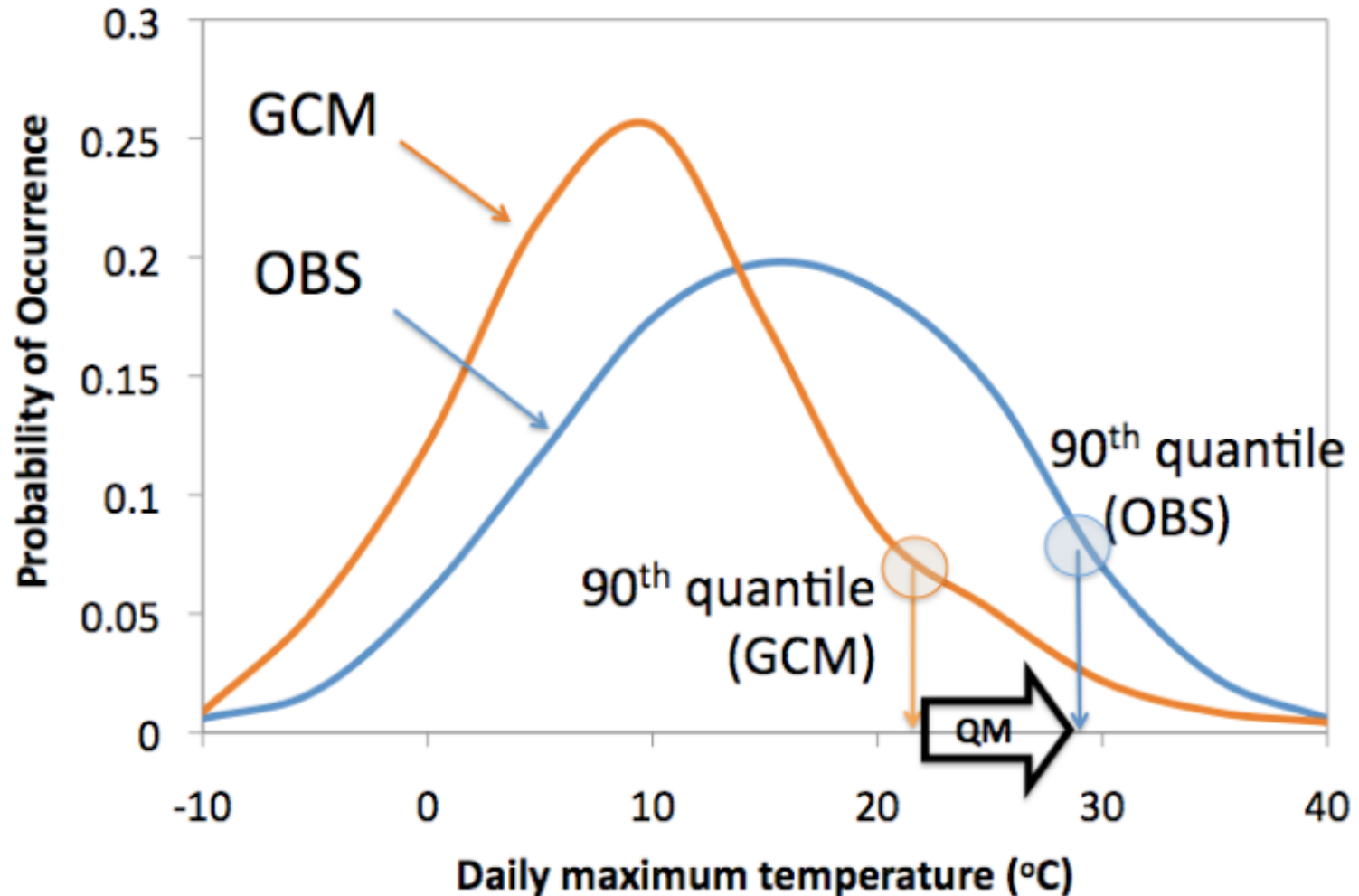
CCSM4 (U.S.)



The primary downscaling method

- **Quantile mapping:**
or **generalized Bias-Correction Spatial Disaggregation (BCSD)**
 - **each quantile of model-derived distribution (past and future) is given an adjustment which is difference between model-simulated quantile value and corresponding value from observed distribution for recent decades**
 - **removes model biases**
 - **used with daily values**
 - **enables capture of changes in entire distribution, including extremes**

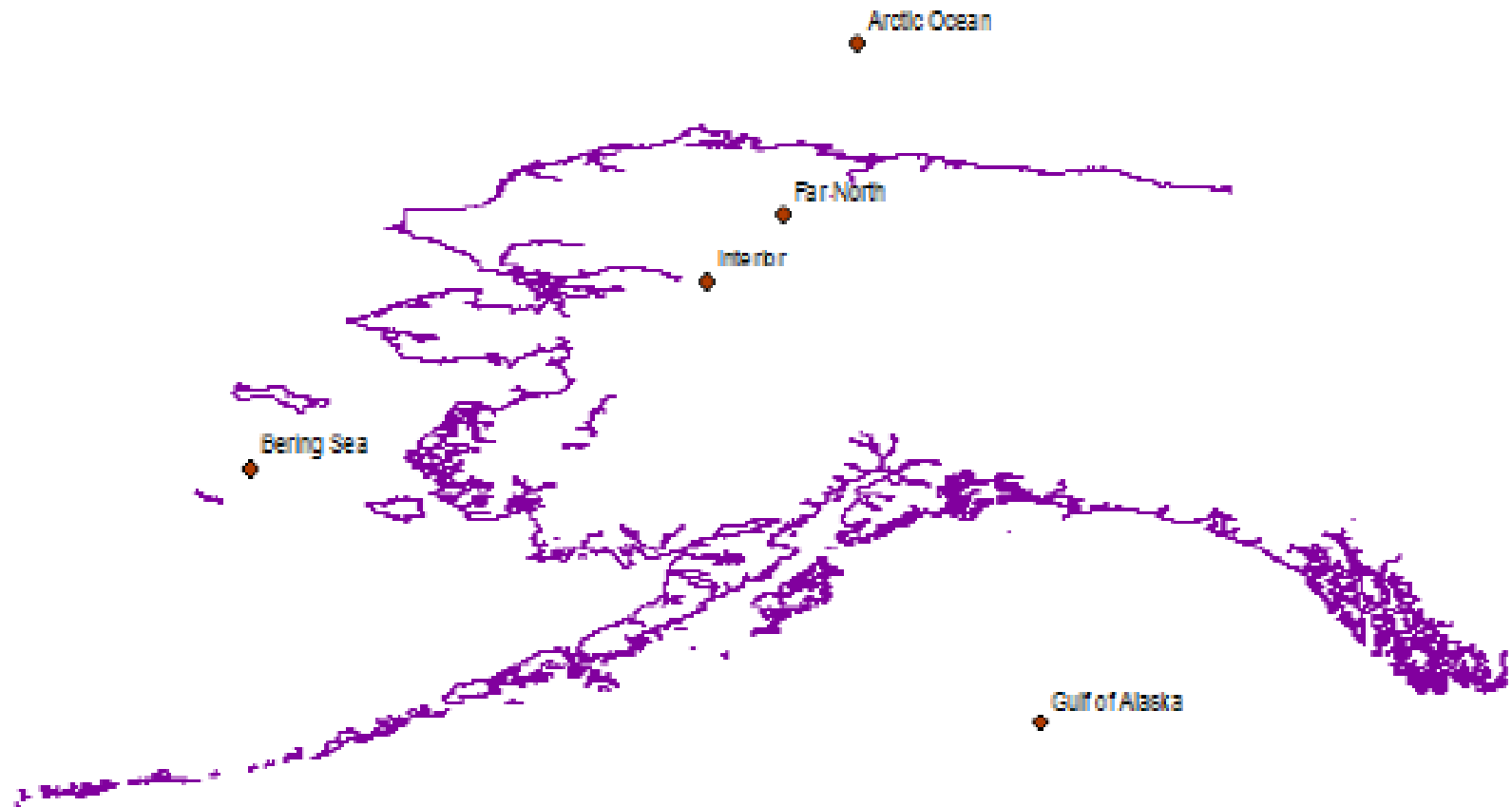
Schematic illustration of quantile mapping



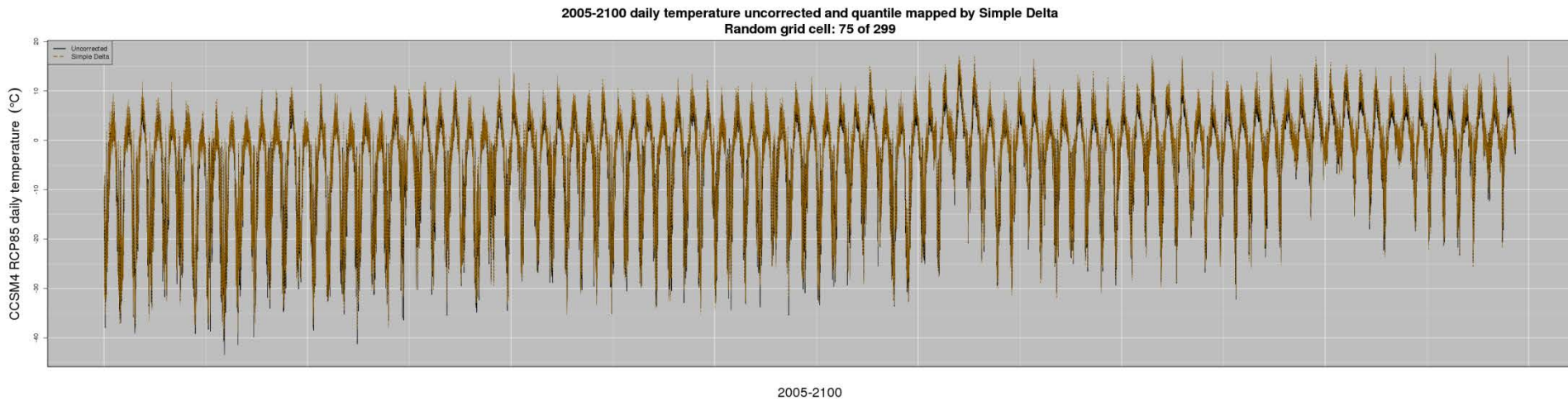
Sample results:

- **Daily surface air temperatures (~sea surface temperatures)**
- **One model only (CCSM4)**
- **One scenario: RCP8.5 (high-emission scenario)**

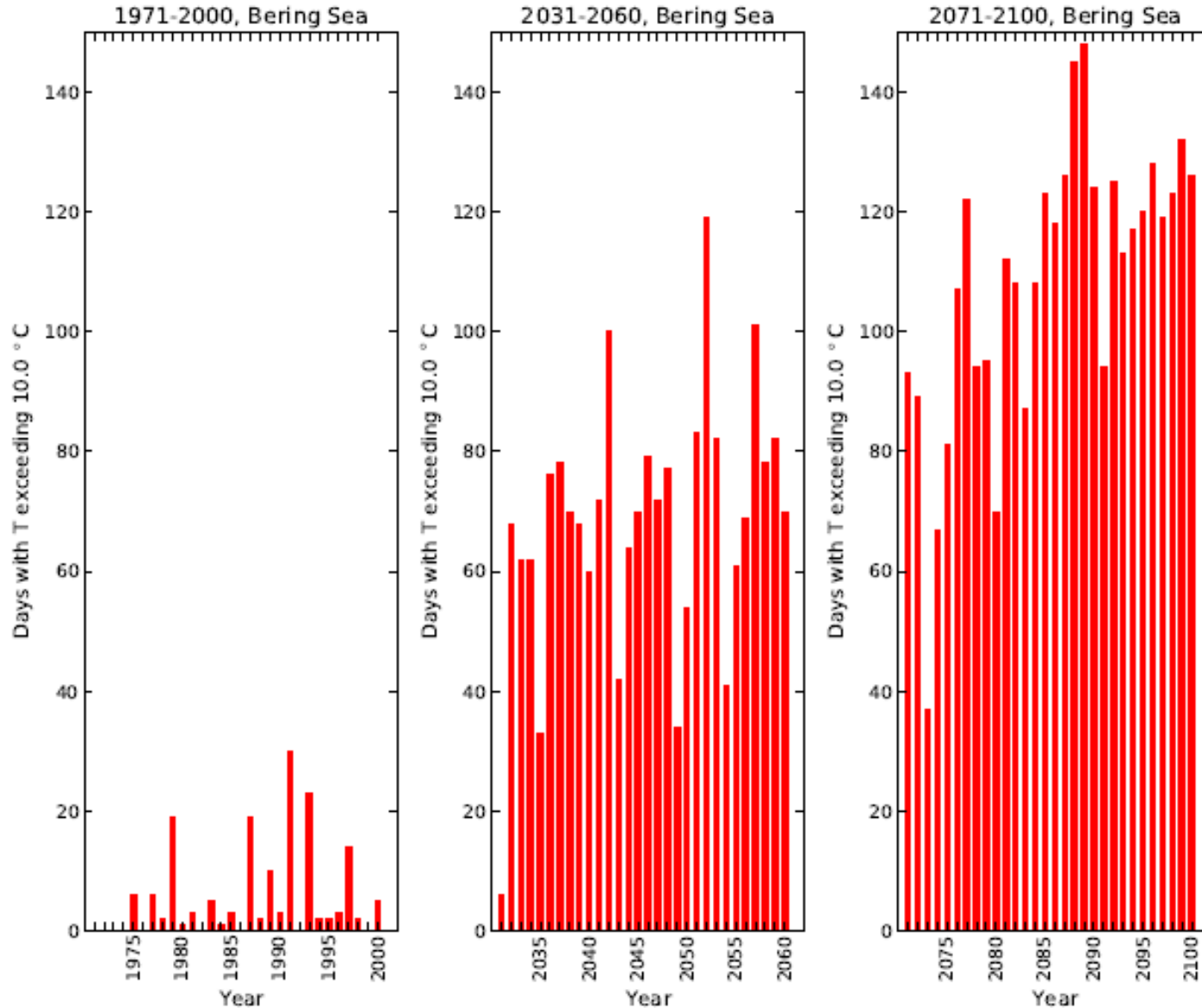
Initial test points



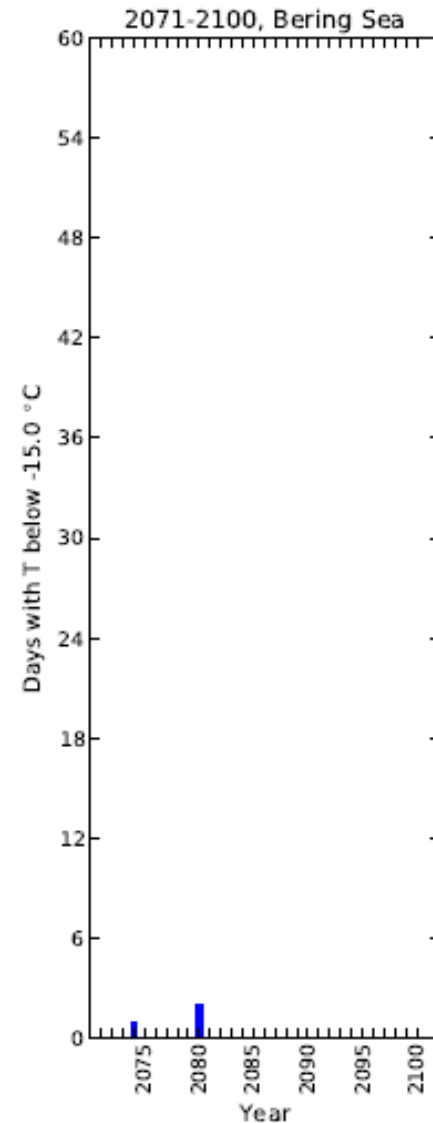
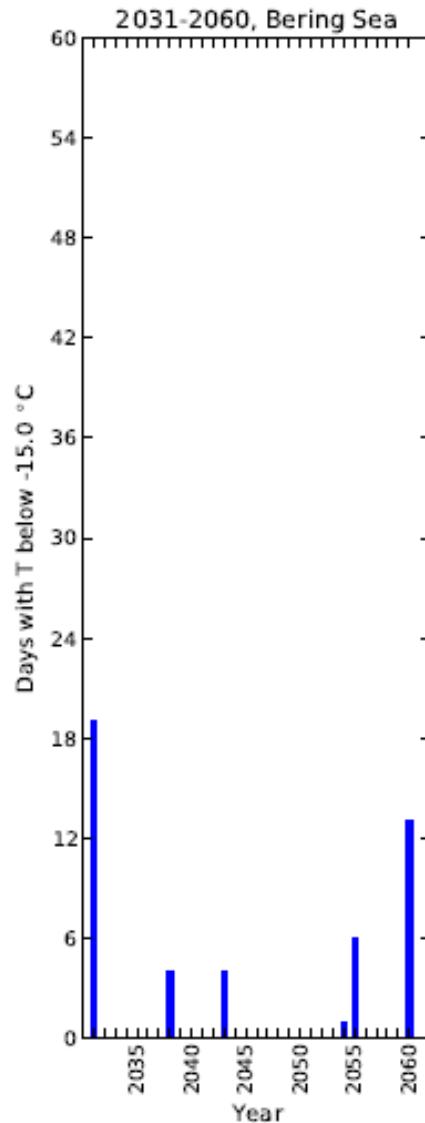
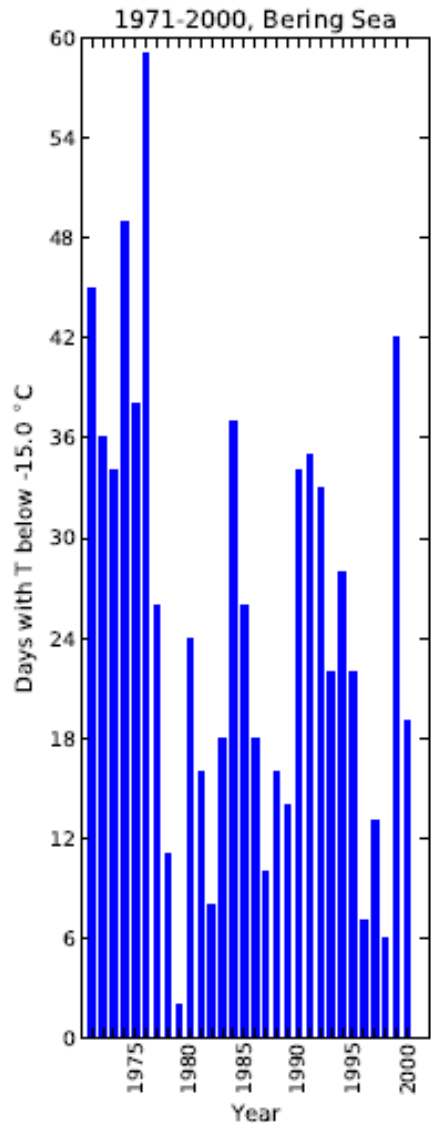
Sample time series of model-derived daily temperatures, 2005-2100



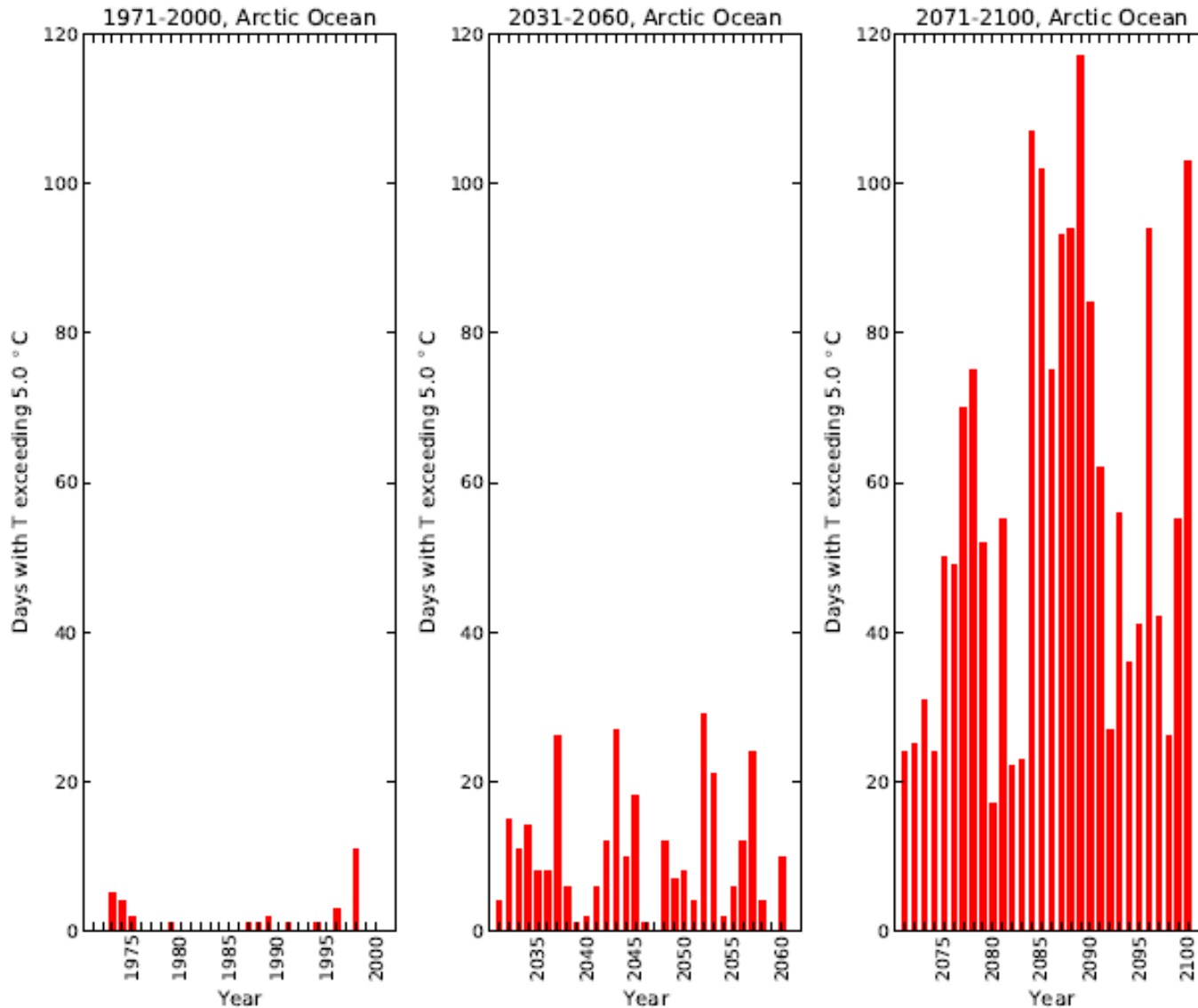
Bering Sea: Days warmer than 10°C



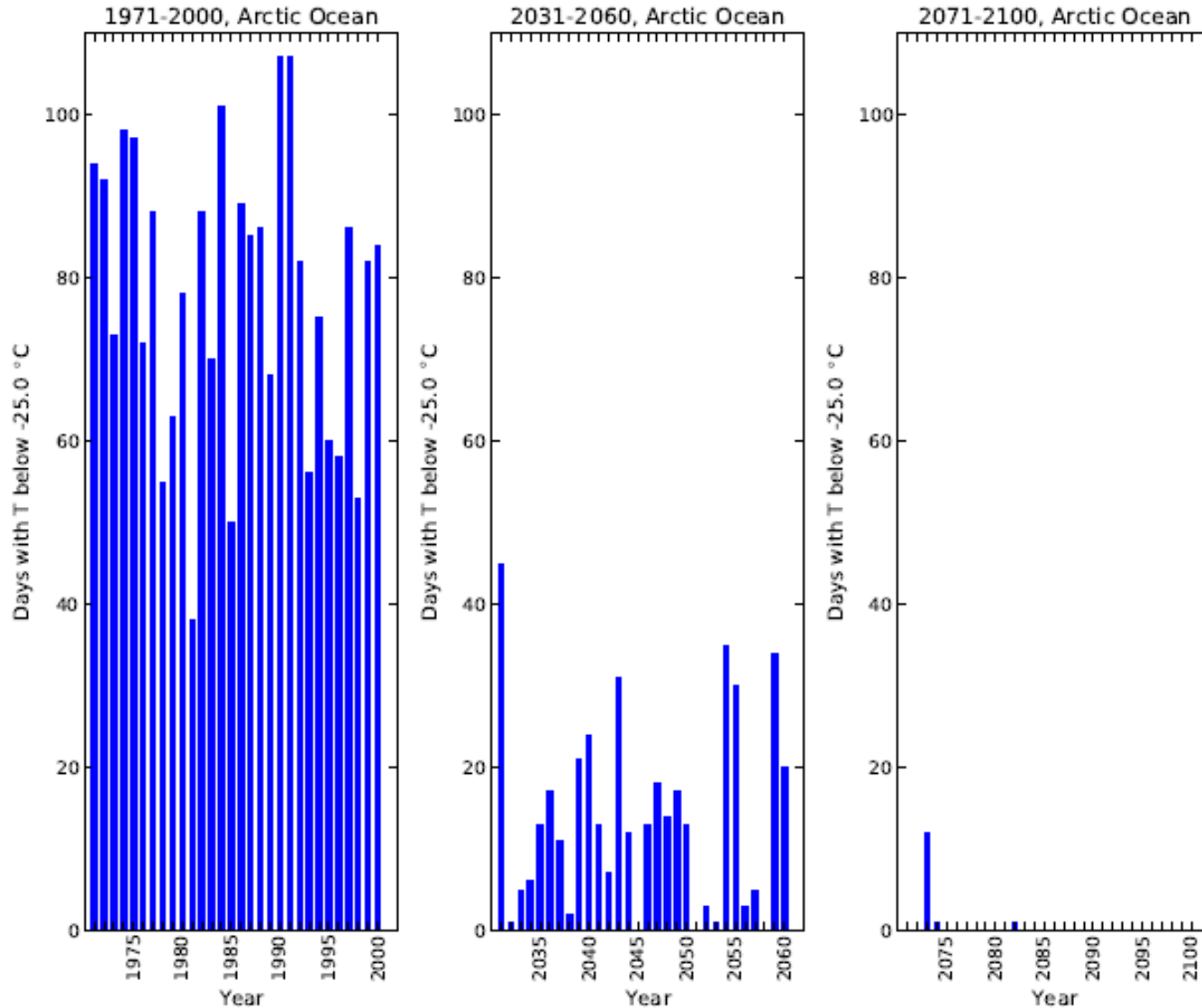
Bering Sea: Days colder than -15°C



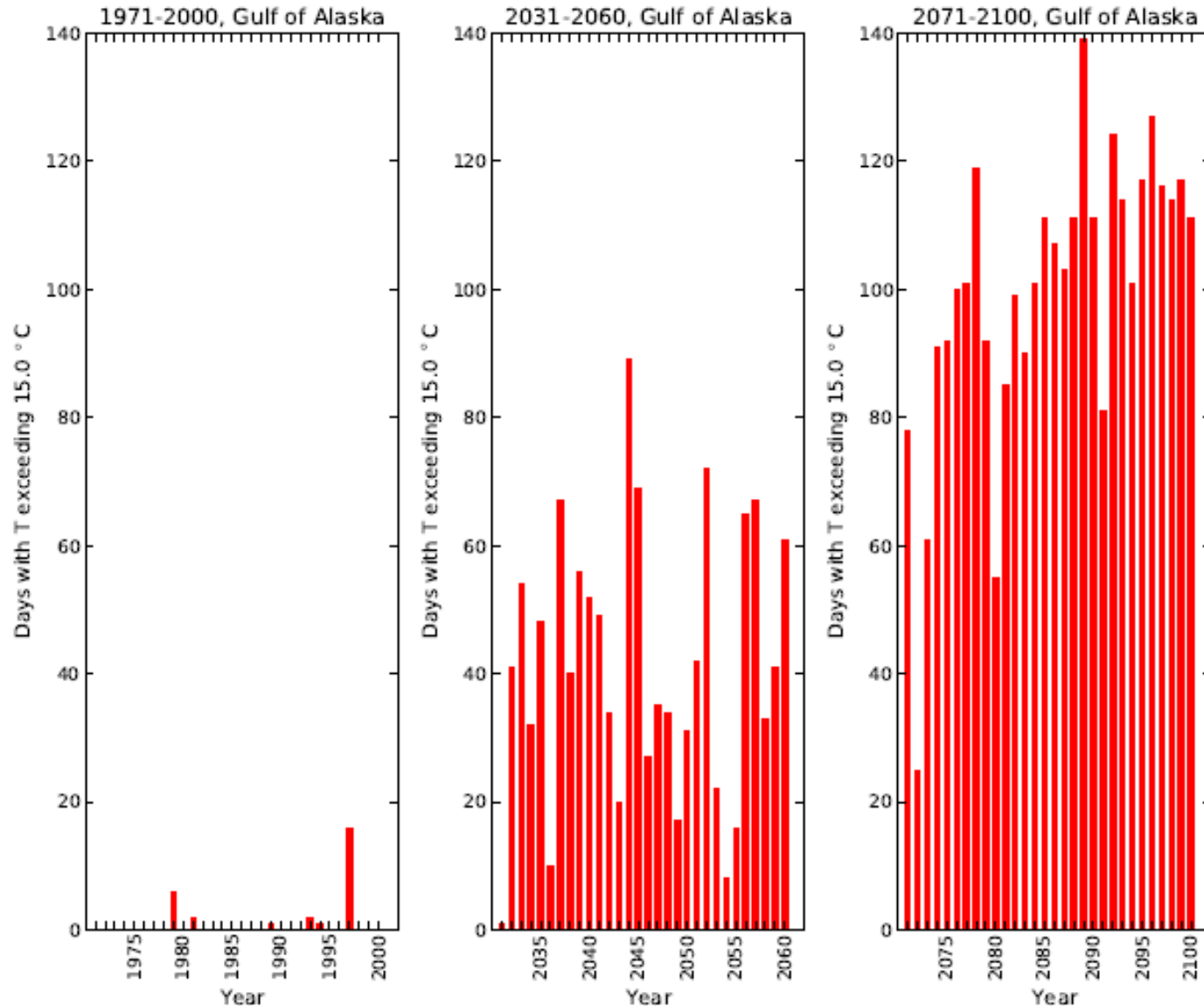
Chukchi Sea: Days warmer than 5°C



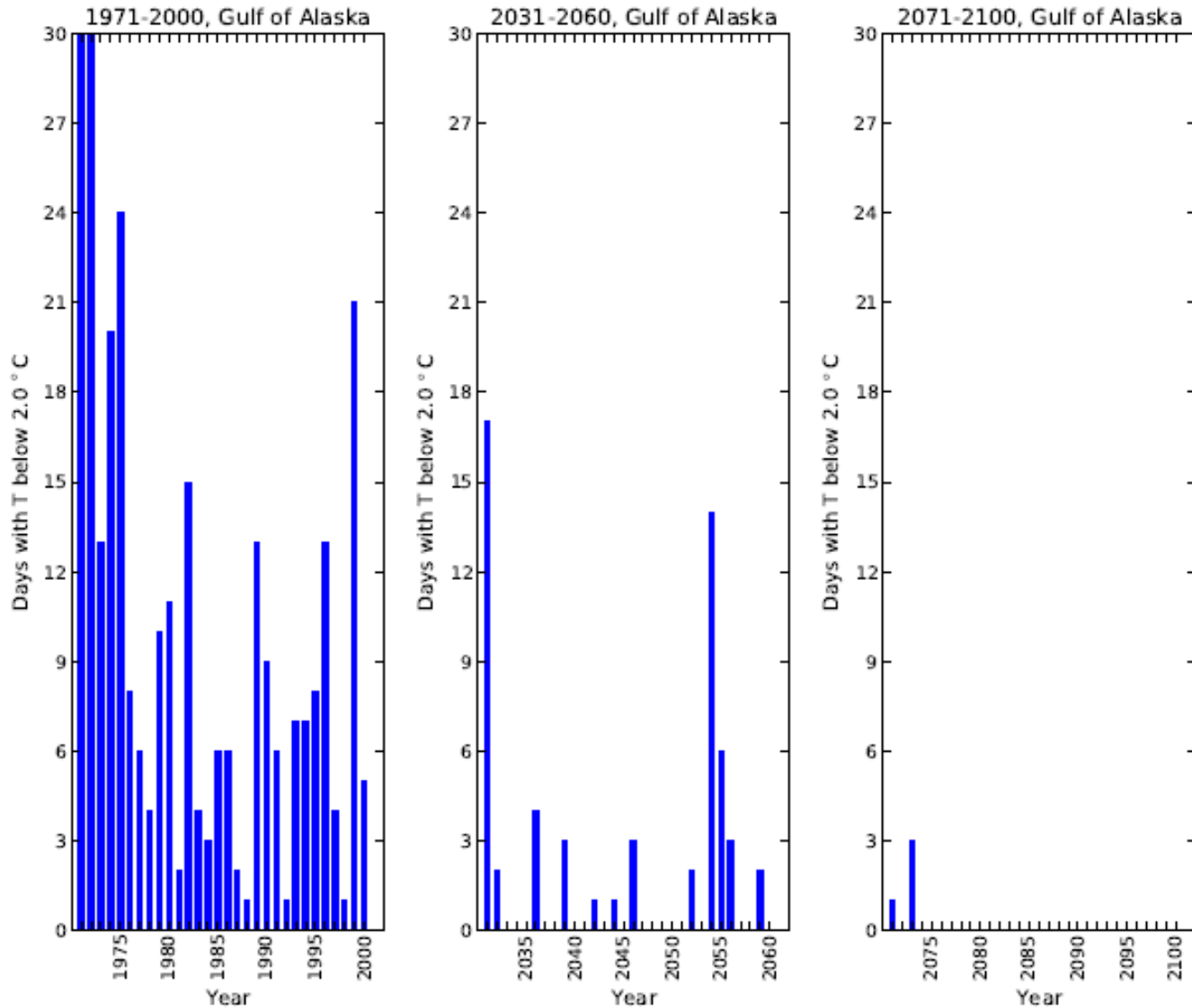
Chukchi Sea: Days colder than -25°C



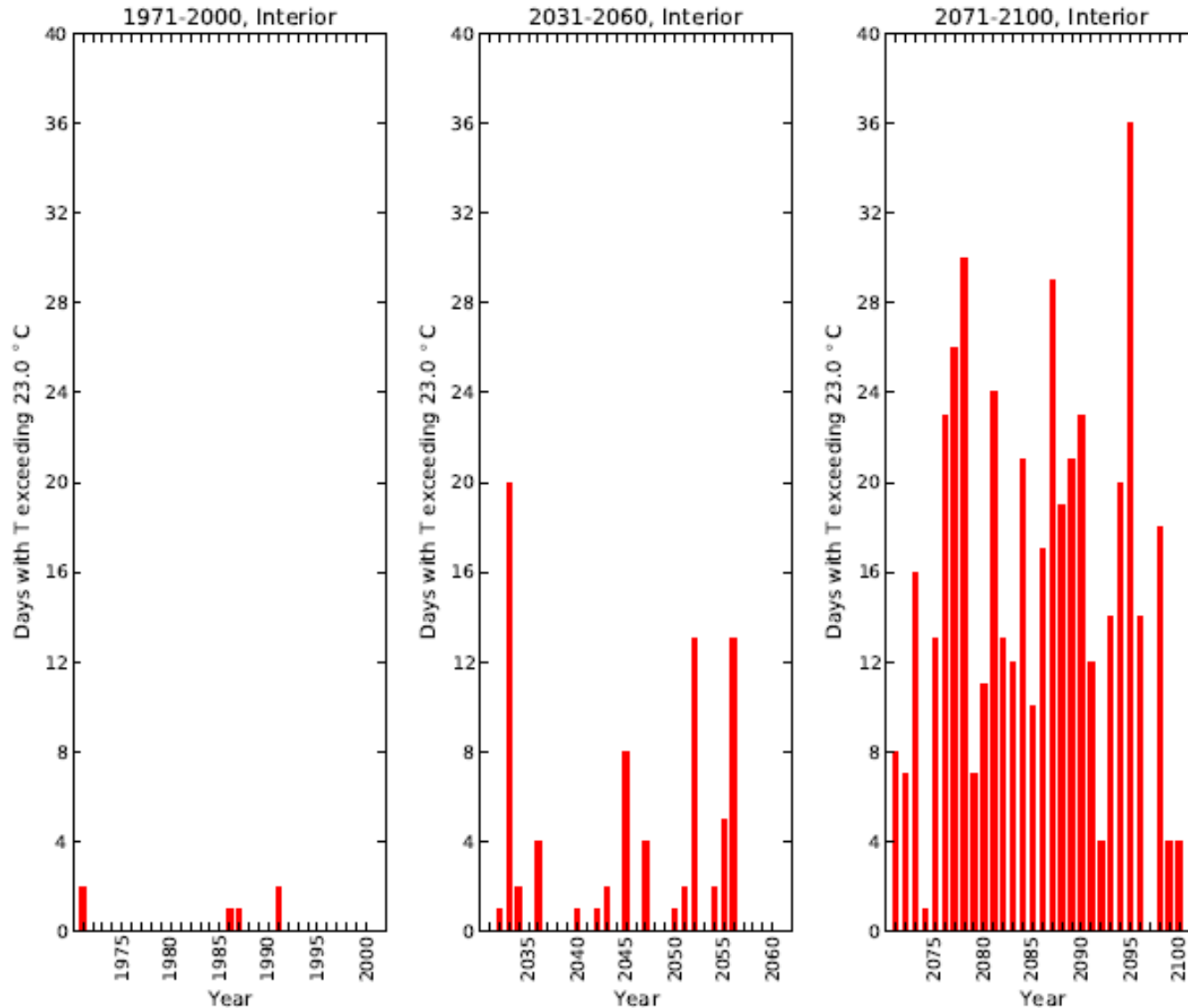
Gulf of Alaska: Days warmer than 15°C



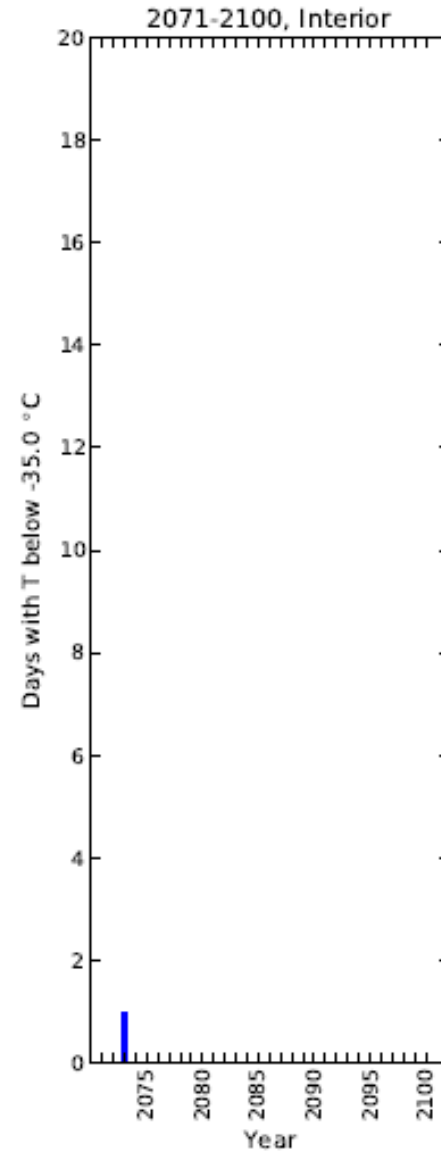
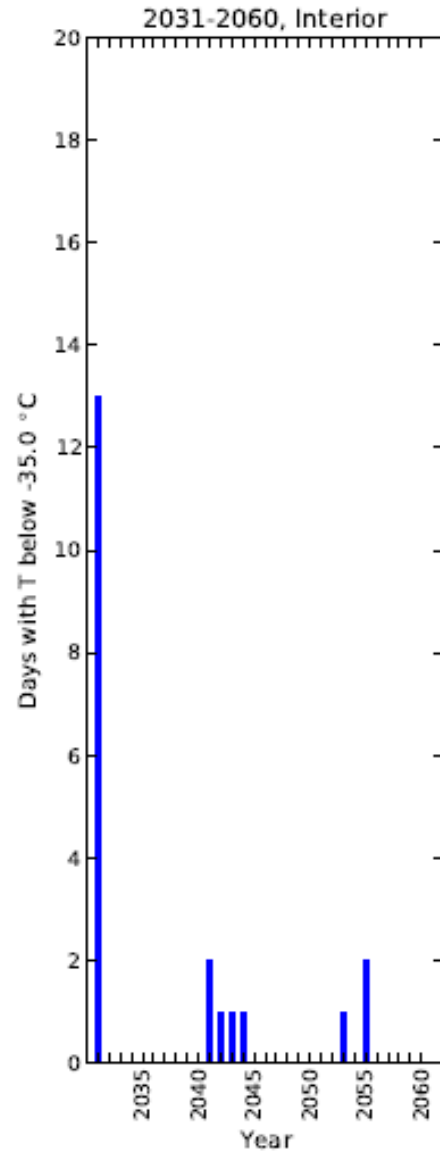
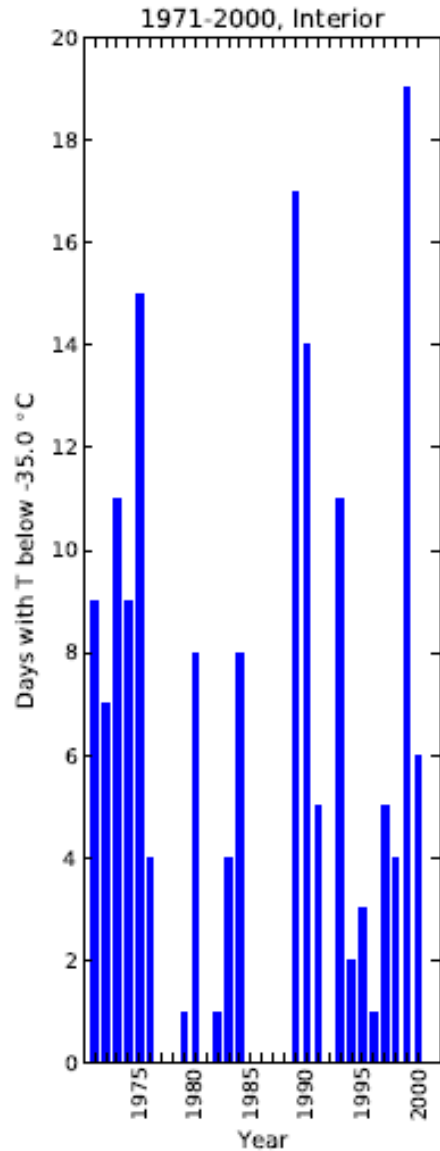
Gulf of Alaska: Days colder than 2°C



Interior: Days warmer than 23°C

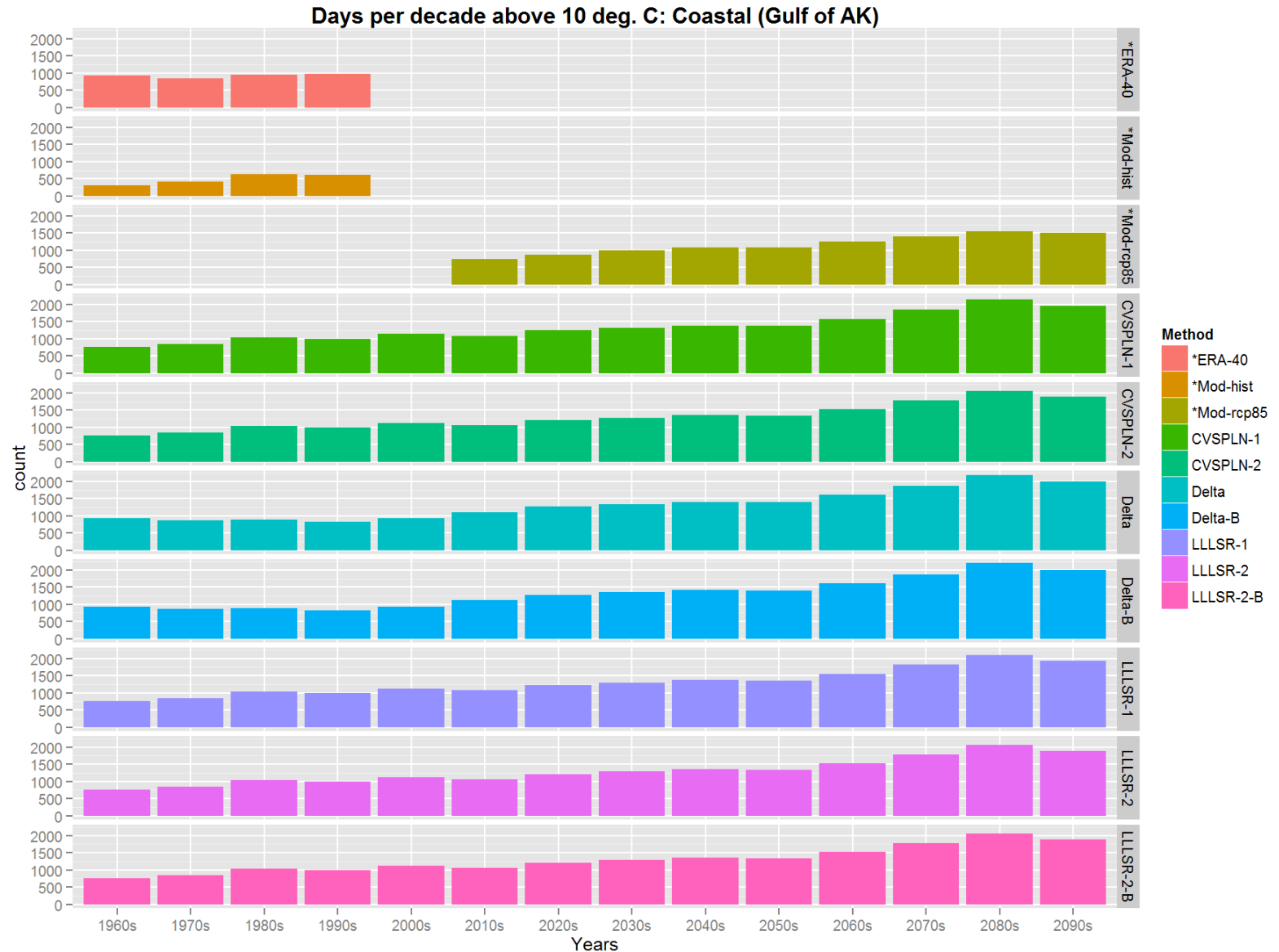


Interior: Days colder than -35°C



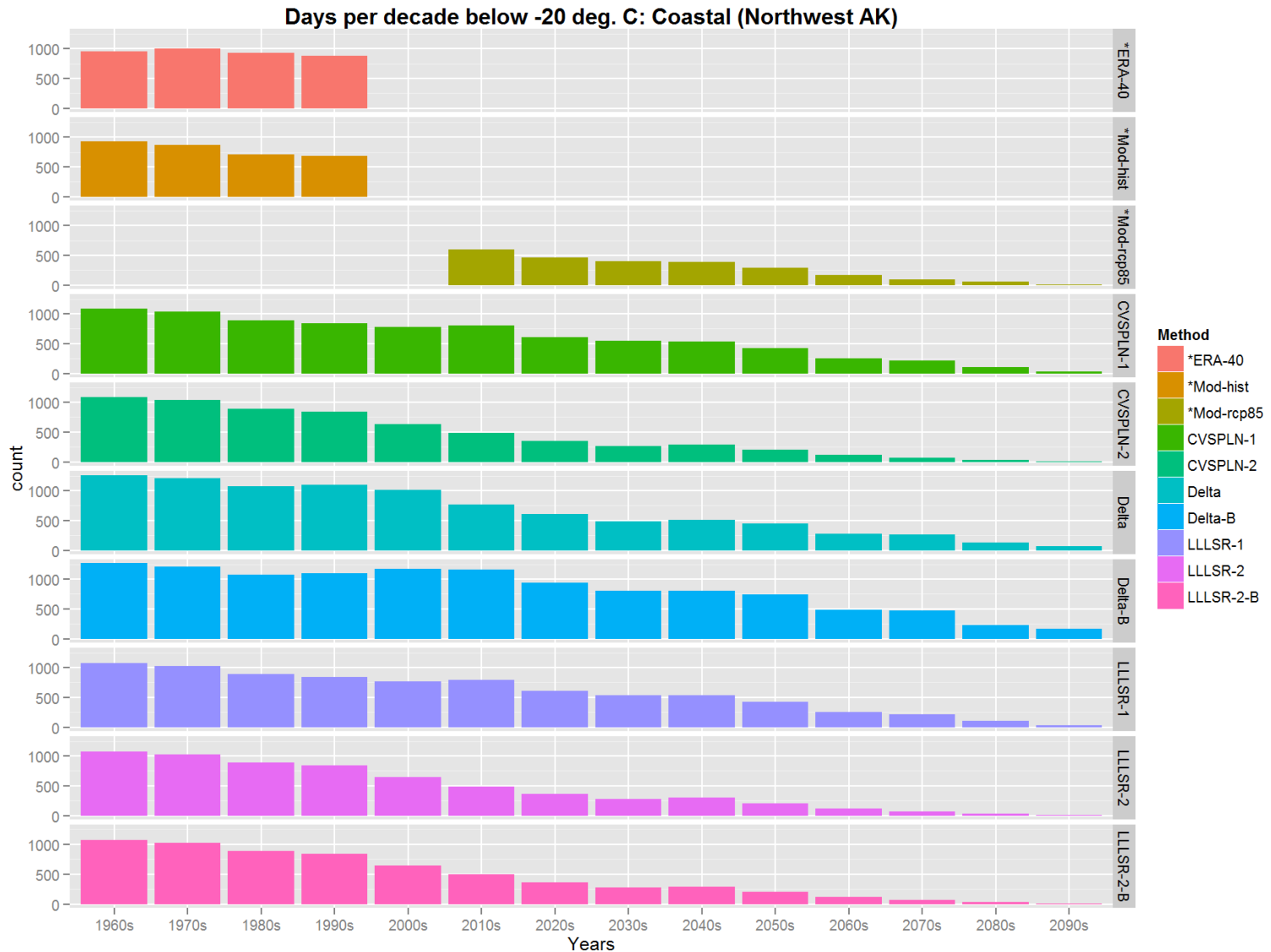
Decadal occurrences of days warmer than 10°C: Gulf of Alaska

-- sensitivity to method of quantile mapping



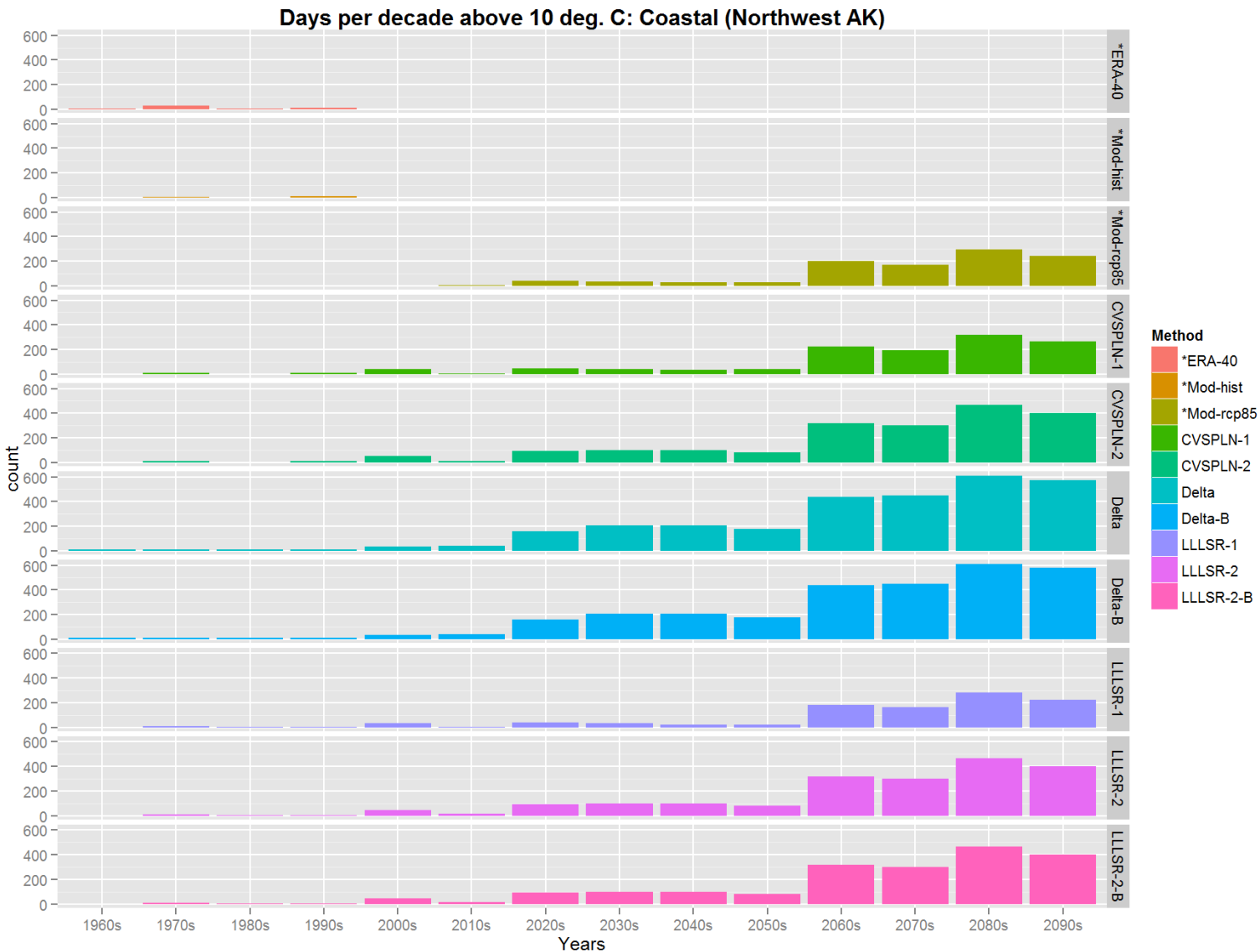
Decadal occurrences of days colder than -20°C : NW Alaska coast

-- sensitivity to method of quantile mapping



Decadal occurrences of days warmer than 10°C: NW Alaska coast

-- sensitivity to method of quantile mapping



What distinguishes this STAMP subproject from previous downscaling?

- **Extension to offshore region (+ coastal station sites)**
- **New generation of global climate models (CMIP5)**
- **Extension to daily data and model output → extreme events**

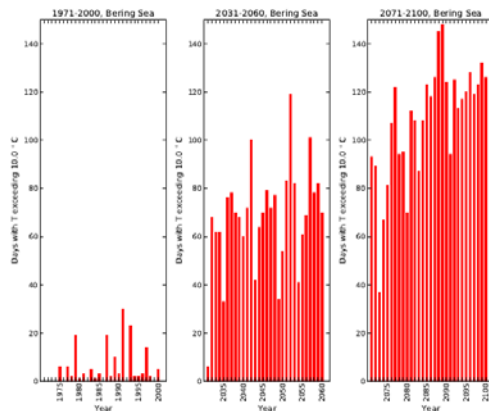
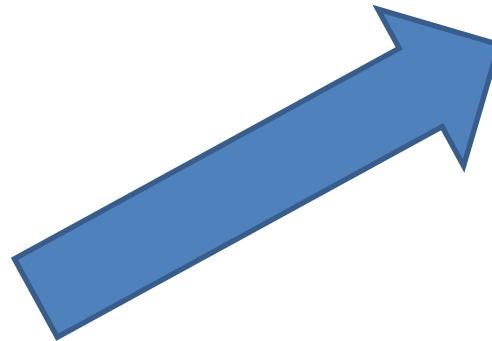
Upcoming:

- **Downscaling of winds (storm events)**
- **Availability of sea ice database to enable assessment of changes in occurrence of extremes with ice-free coastline (e.g., coastal flooding/erosion events)**



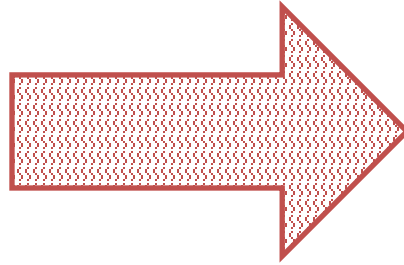
Decision Process

- Expert Opinion
- Advisory Groups
- Public Meetings
- NEPA Process
- GIS
- Other Tools & Models



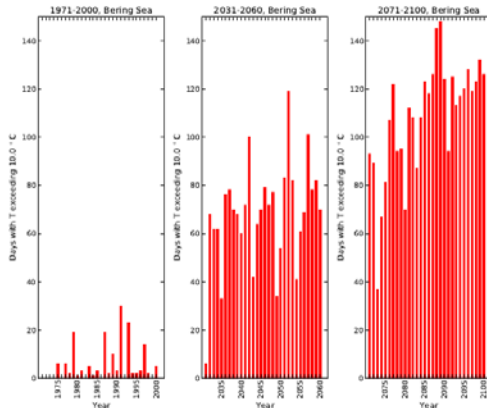
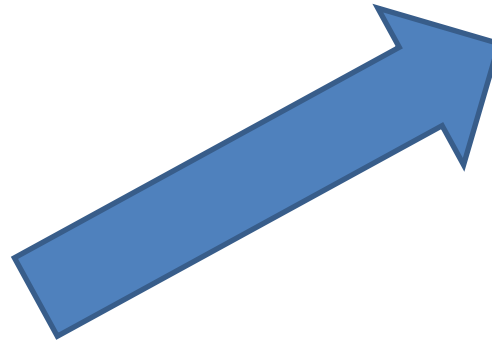
Climate Projections
Temperature
Precipitation
Wind

Other Factors:
Global Markets
Fuel Prices



Decision Process

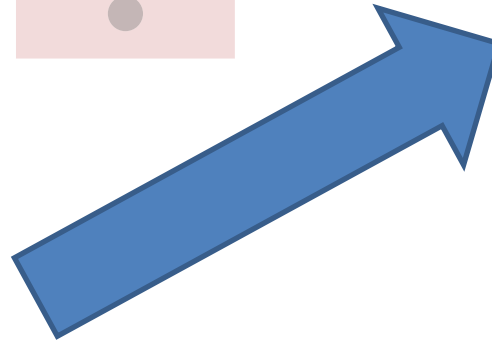
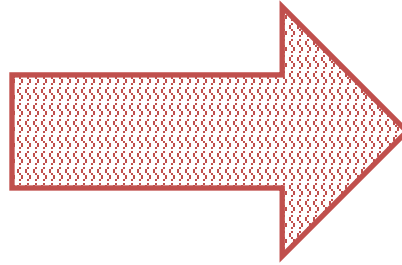
- Expert Opinion
- Advisory Groups
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- NEPA Process
- GIS
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Climate Projections
Temperature
Precipitation
Wind

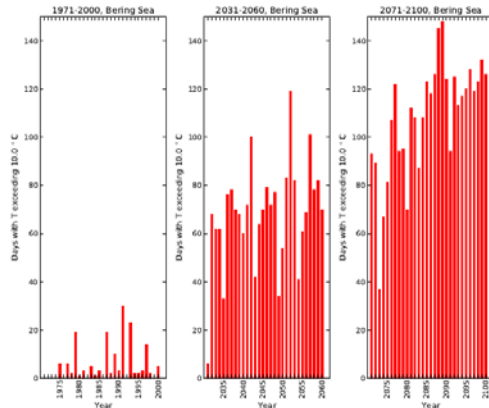
Other Factors:
Global Markets
Fuel Prices

Existing unknowns
Scientific uncertainty



Decision Process

Expert Opinion
Advisory Groups
Public Meetings
NEPA Process
GIS
Other Tools & Models

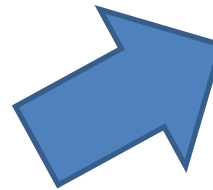


Climate Projections
Temperature
Precipitation
Wind

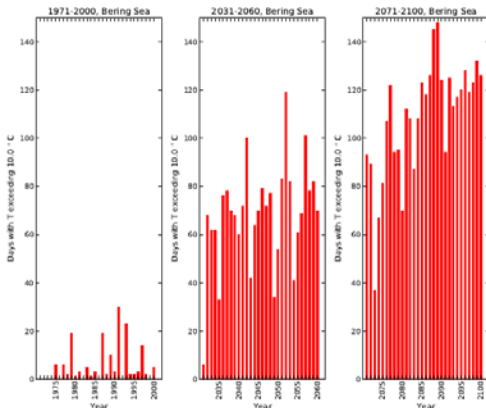
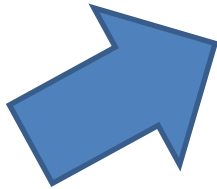


Decision Process

- Expert Opinion
- Advisory Groups
- Public Meetings
- NEPA Process
- GIS
- Other Tools & Models



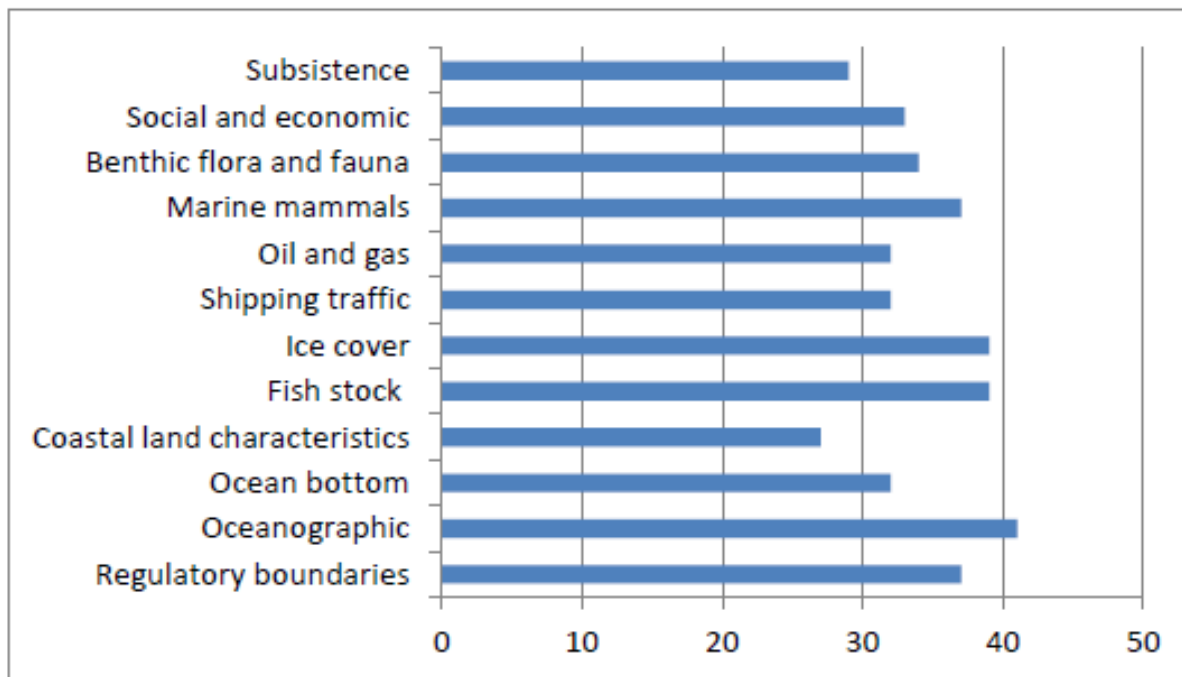
Interpretation
Context



Climate Projections
Temperature
Precipitation
Wind

Projections of future conditions provide a forecast of how these might change over time.

Types of Geospatial/Mapping Data that Respondents Currently Use



KEY FINDING:

- While all data types received very similar amounts of usage, the most commonly used types of data were oceanographic, fish stock, ice cover, marine mammals and regulatory boundaries.
-



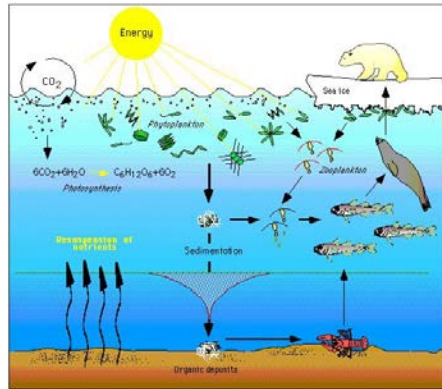
Ecosystem Impacts:

- Photoplankton*
- Zooplankton*
- Food Web*

Species Impacts



Decision Process

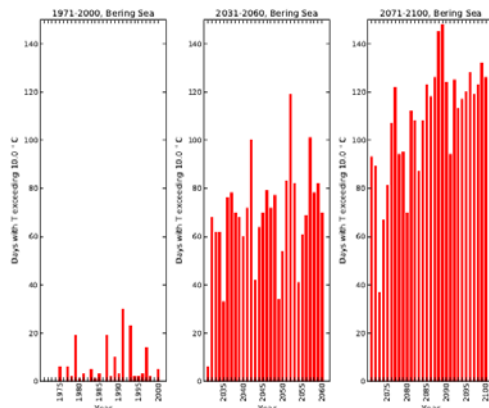


Drawn by Christopher Krembs

arctic.noaa.gov



Current Scientific Unknowns



Climate Projections

- Temperature*
- Precipitation*
- Wind*

Example....

Fishery Management Plan

for Fish Resources

of the Arctic Management Area



North Pacific Fishery Management Council
605 W. 4th Avenue, Suite 306
Anchorage, Alaska 99501

PHONE: (907) 271-2809
FAX: (907) 271-2817

August 2009

Table ES- 1 Arctic Fishery Management Policy

The Council's policy is to proactively apply judicious and responsible fisheries management practices, based on sound scientific research and analysis, to ensure the sustainability of fishery resources, to prevent unregulated fishing, and to protect associated ecosystems for the benefit of current users and future generations. For the past 30 years, the Council's management policy for Alaska fisheries has incorporated forward-looking conservation measures that address differing levels of uncertainty. This management policy has in recent years been labeled the precautionary approach. Recognizing that potential changes in productivity may be caused by fluctuations in natural oceanographic conditions, fisheries, and other non-fishing activities, the Council intends to continue to take appropriate measures to insure the continued sustainability of the managed species. It will carry out this objective by considering reasonable, adaptive management measures, as described in the Magnuson-Stevens Act and in conformance with the National Standards, the Endangered Species Act, the National Environmental Policy Act, and other applicable law. This management policy takes into account the National Academy of Science's recommendations on Sustainable Fisheries Policy.

As part of its policy, the Council intends to consider and adopt, as appropriate, measures that prevent unregulated fishing, apply the Council's precautionary, adaptive management policy through community-based or rights-based management, apply ecosystem-based management principles that protect managed species from overfishing and protect the health of the entire marine ecosystem, and where appropriate and practicable, include habitat protection and bycatch constraints. All management measures will be based on the best scientific information available. Given this intent, the fishery management goals are to provide sound conservation and sustainability of the fish resources, provide socially and economically viable fisheries for the well-being of fishing communities, minimize human-caused threats to protected species, maintain a healthy marine resource habitat, and incorporate ecosystem-based considerations into management decisions.

This management policy recognizes the need to balance competing uses of marine resources and different social and economic goals for sustainable fishery management, including protection of the long-term health of the ecosystem and the optimization of yield from its fish resources. This policy will use and improve upon the Council's existing open and transparent process of public involvement in decision-making.

Decision Process



Navigation



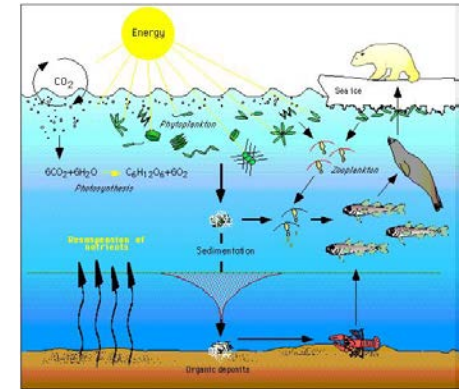
dippity.com

Coastal Vulnerability



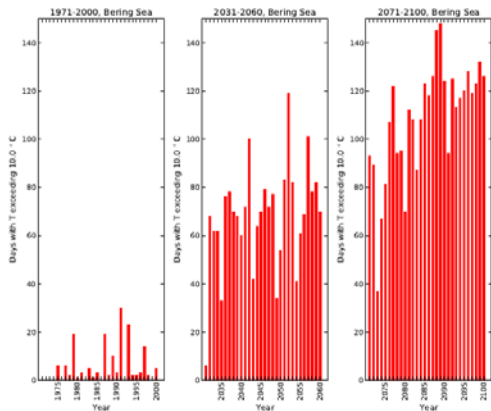
msnbc.com

Habitat



Drawn by Christopher Krembs

arctic.noaa.gov



Climate Projections
Temperature
Precipitation
Wind

